物理研究论文（中英文对照）

光子是物质的最基本粒子

醉放先生著

Photon Is the Ultimate Elementary Particle of Matter

Zhuopeng Xian

内容简介：

本书有中英文论文对照。

论文利用熵增加原理、

推导出组成物质的最基本

粒子是光子，并进一步说

明光子的物理特性、物理

常量影响着宇宙的物理规

律与物理常量，试图为基

本粒子、大统一物理的研

究提出一个方向。

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提要：利用熵增加原理、推导出组成物质的最基本粒子是光子，并进一步说明光子的物理特性、物理常量影响着宇宙的物理规律与物理常量。本文试图为基本粒子、大统一物理的研究提出一个方向。

关键词：光子，基本粒子，信息，熵，

静质量，大统一物理。

1、前言

当今物理学界仍在不断寻地找物质的基本粒子，但基本粒子是什么？人们现在仍难以作出正确的回答。在易经里，我们知道：太极生两仪，两仪生四象，四象生八卦，八卦生宇宙万物。而太极者，无极也。这不就是零物质吗？我们知道光子的静质量是零，若这零物质是光子，那么光子不就是“最基本粒子”吗？我们知道无限小的极限是 0，那么基本粒子的极限不就是光子吗？

同时，现在物理学家们又正在努力寻找宇宙的物理规律、物理常量，努力寻找物理的大统一理论。若我们确定了什么是最基本粒子，那么这最基本粒子的物理规律、物理常量就应与宇宙的物理规律、物理常量有着必然的联系。

现在的超弦理论被部分人认为是大统一理论，一个能在单独的包罗万象的协和的数学框架下描写自然界所有力的理论。在弦理论看来，弦是宇宙物质组成的最基本单元，所有的基本粒子如电子、光子、夸克、中微子都是它的不同具体形态。到现在为止，弦理论还只是一种假说，人类尚未观测到基本的弦。超弦论的实验验证和证伪存在着极大的

困难，由于那些额外维度的空间被卷曲得如此之小，必需建造一个尺度大如银河系的粒子加速器才行。

基于数学领域的哥德尔不完备性定理，在任何公理化形式系统中，总存留着在定义该系统的公理的基础上既不能证明也不能证伪的问题。也就是说任何一个理论都有解决不了的问题。因此，大统一物理不是包含所有各分枝物理的理论，而是各分枝物理的共同部份、基础部份。他应是简单的、优美的。

现本人试图从光子的角度为基本粒子、大统一物理的研究提出一个方向。本文是建立在旧有的理论（相对论、热力学定律）基础上的一个新的推论，而不是建立在一个新的假设之上。

2、信息的量化

香农(Claude E. Shannon)指出，信息是对体系的统计描述的一种性质，是体系的一种基本属性，即它们的组织化程度的度量。香农证明的一个基本定理表明，一个体系的信息含量等于对该体系的完备的统计描述进行编码所需的二进位数最少位数。一个体系的信息所反映的是其可能的存在状态的量值。量度信息的单位是比特（bit）；一比特信息是两个相等的可能性之间决定一个所需的信息量。如某个体系有 2^r 个可能的存在状态，那它的信息就是 r 比特。

对可能的存在状态的观测受测不准原理、测量水平等所制约，不同测量水平所测量的信息记录是不同的。在一个完全封闭的系统里，可精确地描述出大量的态，我们常称之为微观态。在量子力学里，这就是系统可能的量子态。这些微观态根据粗粒化区分的不同性质，分类聚集到一块儿（可称之为宏观态）。在一给定宏观态中的微观态可以看成是彼此等价的，所以我们通常只关心微观态的数目。

同时，不知道一团物质的终极组成部分或其最深层次的结构，我们就无法计算其终极信息容量，也无法计算其香农熵。但是，我们可以找到能计算其信息容量的最深层次的结构。按照微型化技术目前这样快的发展速度，我们可以设想将来某日夸克能被用来存储信息，也许是一个夸克一比特。

3、香农熵

香农熵反映了在一个随机试验（或随机变量）的不确定性。一个随机试验可用：

$$X=\begin{pmatrix}1 & 2 & \cdots & n\\ p_1 & p_2 & \cdots & p_n\end{pmatrix}$$ 表示。

其中 $1, 2, \cdots\ldots, n$ 为可能发生的结果，p_i 为 i 发生的概率。X 的不确定性大小取决于 n 的大小与 p_i 分布的均匀程度。这个不确定性是 $(p_1, p_2, \cdots, p_n)$ 的一个函数，记为 H，它具有如下性质：

（1）对称连续性，即 $H(p_1, p_2, \cdots, p_n)$ 是 $(p_1, p_2, \cdots, p_n)$ 的对称连续函数；

（2）$H(0, 1)=0$;

（3）如 $q=p_n+p_{n+1}$ 则

$$H(p_1, p_2, \cdots, p_n, p_{n+1})$$

$$=H(p_1, p_2, \cdots, p_{n-1}, q)+qH(p_n/q, p_{n+1}/q)。$$

通过数学的推导，得香农熵：

$$H(X)=H(p_1,p_2,\ldots p_n)=-\sum_{i=1}^{n} p_i \log_2 p_i$$

log 的底我们取 2，H(X)的单位是比特（bit）。

如（X，Y）为二元随机变量，取值为 (x, y)，$x=1, 2, \cdots, m$，$y=1, 2, \cdots, n$；联合概率分布为 p_{ij}，则联合熵为：

$$H(X,Y)=-\sum_{i=1}^{m}\sum_{j=1}^{n}p_{ij}\log_2 p_{ij}$$

称 $H（Y|X）=H（X，Y）-H（X）$ 为 Y 关于 X 的条件熵，它表示条件不确定性。当 Y 不依赖于 X 时，即 X、Y 相互独立时 H（Y | X）=H(Y)，得：

$$H（X，Y）= H(X)+H(Y)$$

从概念上来说，热力学熵和香农熵是等价的，当香农设法量化一条消息中的信息时，他自然而然地得出了一条和玻尔兹曼一样的公式。玻尔兹曼熵所代表的不同组成方式的数目反映了为实现某种特定组成方式所必须知道的香农信息量。

4、熵和信息的一个守恒定律

熵和信息有一个守恒定律，就是一个体系的信息与熵的和保持守恒，并等于该体系的最大信息或最大熵。即：

$$H+I=H_{max}=I_{max}=const$$

H 和 I 表示熵和信息的值，H_{max}和 I_{max}表示熵和信息最大的可能值。

熵增加原理可描述为信息减少原理，即是一个孤立体系的信息一定能达到所能达到的最小信息。

熵是一种不确定性的量度。当信息被获得和记录下来，需要消耗能量，这时不确定减少了，而与此同时记录中的信息增加了。当记录被擦掉时，记录中的信息减少了，但整个封闭系统情形的不确定至少增加了相同的数量。

同时，熵与粗粒化有关，即与被描述系统详尽的程度有关。的确，一个体系如果所有的细节都考虑了的话，那么在

数学上就可以认为熵不会再增加，熵将保持不变。但事实上，一个分为许多部分的体系常常只用它的某些变量来描述，这些比较少的变量的有序性会随着时间而散失到其他变量中去，于是前者也不能再看成是有序的了。这就是热力学第二定律的真正意义。

无论是对信息、熵的记录，都与测量水平、所考虑的变量有关。当我们用更准确的测量、考虑更多的变量，就会发现更微观的信息。

5、宏观信息向微观信息的转换

概率的均匀分布和不均匀分布表示了一个体系的信息含量方面的一个质的差别。我们将空间分割成 2^r 个“宏相格”，我们把宏观信息确定为这些宏相格所对应的一组概率所需的信息；确定概率在宏相格内部的分布所需的信息，则定义为微观信息；但实际上，我们可把每一个“宏相格”分割成 2^q “微相格”，我们可以把微观信息确定为所有这些微相格所对应的一组概率所需的信息。同时，我们可以把宏观信息看作是我们对体系的统计性质的知识，而把微观信息看作是对各个微观粒子的具体知识，具体来说就是微观信息代表了我们对各个粒子的速度之间的相互关联的了解。

我们设想一个假想实验，在空气完全静止的封闭空间的一角，放置一瓶密封香水。一瓶密封香水放在空间的一个“宏相格”中，它占据的体积是 $1/2^r$，其宏观信息就是 r；随着时间的推移我们看不到宏观信息的变化，这是由于它在一

个制约条件下（如瓶被密封等）。如把瓶盖打开，随着时间的推移，香水分子就会挥发，其宏观信息不断减少，直至全部宏观信息转变为微观信息，总的信息量并没有变化。我们还可以把微相格再细分下去，随着时间的继续推移，用更准确的测量、考虑更多的变量，就会发现微观信息就向着更微观的信息转变。

若我们把更微的相格的长度确定为Planck长度，根据测不准原理，我们知道，这将是最微观的信息。这时，若把这样的更微的相格再向下细分，那么，信息就消失在量子涨落中，因为我们不可以再测量了；或者说，根据信息减小原理，当这个最微观的信息继续减小时，信息就消失在量子涨落中了。同时，一个名义上孤立的体系同世界其余部份的不可避免的相互作用是以微小的随机扰动的方式来进行的，这的微扰破坏粒子之间的关联，能消耗微观信息。

宏观信息可转变为微观信息，反之亦然。从量子涨落中产生信息，产生有信息的基本粒子，通过这些粒子的相互作用、相互关联就产生了更多的信息，产生了宏观信息，但这个过程需要消耗能量。

6、光子是物质的最基本粒子

我们知道，电子有 2^2 个可能的存在状态（它有两种电荷两种自旋状态，是现在的测量水平下所能测到的），要指定具体什么电子，需要 2 个二进位数，所以单独一个电子的信息是 2bit。对于光子，自旋方向有平行与反平行于物质运动方向两种，他最少的可能存在状态应是 2^1 个，所以单独一个光子的信息是 1bit，这是现在人们的测量水平所观测得到的。对于由大量光子组成的一个孤立体系，左旋与右旋相等混合并均匀地分布，这时这个体系的信息是 0bit。

基本粒子中信息容量最小的信息应该是 1bit，现在我们来看看，在测不准原理制约下，基本粒子中信息最小的粒子是不是光子。

我们知道能量与质量是一回事。设 Q 为热量、E 为能量、T 为绝对温标、m 为质量，S 为势力学熵。考虑在一个与外界没有作功的系统中，据热力学第一定律，得：

$dQ=dE=dm$

$dS=dE/T$

由能量均分原理：

$E/T=const$

$dE/E=d(lnE)$

若 $dS\geqslant 0$，则：

$dm\geqslant 0$

考虑一个非平衡的系统，它可以被分成无限多个近似平衡的小系统，由于熵与质量的可加性，我们完全可以相信存在这么一个体系，上式仍然成立。而且，在一个孤立的不可逆体系中，只要有足够的时间，熵一定能达到最大值，信息一定能达到最小值。在测不准原理制约下，我们可以找出能计算其信息容量的最深层次结构的最微观的信息。在这个

最深层次的结构下，当系统信息达到 0 时，微观系统的单一粒子就一定会存在基本粒子中信息最小的粒子。

由相对论，得：

$$dv \geqslant 0$$

v 是组成这个特殊的孤立的不可逆体系的基本粒子的速率。

这说明了熵增加的方向就是使组成这粒子的最基本粒子的速率最终达到光速，粒子最终分解成静质量为零的最基本粒子，也就是说，在一个完全孤立的没有给定任何制约条件的物理体系中，熵增加原理就是使其系统中的总静质量最终为零。从相对论可得知，一个静质量不为 0 的物质是不可能被加速到光速，但我们认为它可以分解为光速的光子。因而，光子是静质量为零、信息为 1bit 的粒子,它就是物质的最基本粒子。也就是说作为速度极限的光子，也是信息最小的粒子，是基本粒子无限细分的极限。

另一方面，我们可以在光子建立参考系观测一个孤立的物理体系，据相对

论，我们会发现，组成这物理体系的全是速度为光速的粒子，即光子。当然，一般地，人们不会在光子建立参考系来观测一个孤立的物理体系，因为这是极端的情况。但是，一个普适的物理定律若不可以在极端的情况下使用，又何以普适呢？

无论从信息减少原理、熵增加原理以及在光子建立参考系观测，我们都可得到结论：光子是物质的最基本粒子。

7、信息和静质量

现在我们设两个光子 A、B，它们以光速运动着，设其动质量（总动能）为 m_A、m_B。由于 A、B 有动质量，还会有电磁等一些特性，所以当 A、B 结合成一个基本粒子－－具有“刚性”的粒子时，光子之间存在着相互作用，这就产生了位能。

这时，我们设 A、B 的位能为 V_A*、V_B*，总动能为 m_A*、m_B*，那么 A、B 的总能量就是：

V_A*+m_A* 、 V_B*+m_B*。

把 A、B 作为一个总体 M，那么 M 的总静质量 m 为：

$m=V_A*+m_A*+V_B*+m_B*$。

由最基本粒子组成的物质的静质量即固有质量就是物质内部各粒子间的相

互作用而产生的位能与物质内部各粒子间的相互运动而产生的总动能之和。

在一个完全孤立的没有给定任何制约条件的物理体系里，由信息减少原理，随着时间的推移，其信息最终为 0bit，可以说是没有信息，这时，整个物理体系的总静质量亦为 0。当一个物理体系有静质量时，就说明它内部存在光子及粒子间的相互作用，它产生了信息；反之亦然，物理体系存在信息（>1bit）也说明它有静质量；物质信息和静质量都是由其内部的各光子及粒子间的相互作用产生的。如一个电子，它有信息（2bit），亦有静质量。但到现在为止，我们仍不能说有多少信息就有多少静质量，而这需要进一步的研究。

光子通过一定的方式组成物质，通过光子之间的相互作用（可以通过力的作用）、通过转化而成为一个有静质量的粒子，这时候，亦就产生了位能，产生了新的信息，产生了静质量，但也许我们已不能观测到其内部的单一光子了。电子——反电子对可以湮灭转化为一对光子，同样，若干个光子是可以转化为电子的。

8、整个宇宙的微观信息

首先，我们把宇宙表示为一条无限长的“直线”模型。为了体现测不准原理，我们必须把一维直线分割成长度相等的小段，小段的长度代表单个粒子的位置所能做到的精确度。如果我们又确定占据每个小段的粒子数目，那么，这个“直线”宇宙就可以用一个由“占有数”构成的、两端都开放的无限数列来表示。于是微观信息就可以这样定义：它使我们能够区分两列具有相同统计（即宏观）性质的这样的占有数数列。现在我们来试图证明这两具数列是相同的。我们从一列占有数数列中选出任意长度的一个子数列，在一个无限数列中，任何有限长度的子数列都将重复出现无限多次。大数定律保证我们经过有限次尝试之后就一定能找到相同统计（即宏观）性质的这样的占有子数列，而且，不管我们选出的子数列有多长，只要长度有限，我们就一定能找到。

我们把上述论证推广到三维无限宇宙中去，只要满足强宇宙原理和局部宇宙结构的大小是有限的要求，那么，把宇宙作为一个整体来看其性质全是统计

性（即宏观）的，它的微观信息根本不存在。

9、光子的物理特性、物理常量影响着宇宙的物理规律与物理常量

光子具有量子化，它的能量为：

$$m=h\nu/c^2$$

其中 h 是 Planck 常数，ν 是频率。

由光子的量子化，我们认为光子是可以合并和分解的。但无论如何，只要静质量为零就是光子。 就单一粒子而言，光子都具有相同的物理特性，只有在不同的场里才表现不同的物理特性。

光子具有量子性、电磁特性等等，光速是它的物理常量。宇宙是由光子组成的，所以光子的物理特性、物理常量影响着宇宙的物理规律与物理常量。若整个宇宙由很多个小宇宙组成，那么每个小宇宙中光子的物理特性、物理常量影响着这个小宇宙的物理规律与物理常量。无论是何种情形，宇宙中的任何事物似乎都是根据科学定律的演化所确定的，而这些则由光子的物理特性、物理常量影响着。对光子物理特性、物理常

量的研究应是现代物理的方向。

我相信，在不远的将来，人们可以了解更多光子的本性，会更好地了解更多光子构成物质的机制。

（作者注：本文是我在 1992 年所写的＜＜能动论＞＞的一部份改写而成，只是关于“证明光子是物质的最基本粒子”的那部份。本文原先把静质量为零的粒子称为零子，但我以为还是使用“光子”一词较好。）

1992 年

Photon Is the Ultimate Elementary Particle of Matter

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Abstract: According to the entropy increases principle, I make a deduction that photon is ultimate elementary particle of matter and further more, it shows photon's physical characteristic and physical constants affect the physical law and physical constants of the whole universe. In this essay, I try to take a lead for the study of elementary particles and the grand unified physics.

Key words: photon, elementary particle, information, entropy, rest mass, grand unification.

1. Preface

Physicists have been searched for elementary particle of matter. Bat what is elementary? People find it hard to answer this question. From china ancient books--*The Book of Changes*, we know that *Taiji* produces *two Yi*. *Two Yi* produce four quadrant, four quadrant produce eight diagrams. Eight diagrams produce all the things in the universe. Grand means endless. But *the taiji* is the great void, isn't it that ZERO matter? We know that photon's rest mass is zero. If the ZERO matter is photon, isn't it that photon is "the ultimate elementary particle of matter"? We know that infinitesimal limit is zero. If so, isn't it that ultimate elementary particle of matter is photon?

Meanwhile, nowadays physicists are trying hard to search for the physics law, the physical constants and the theory of grand unification. If we have defined what the ultimate elementary particle is, we're then sure that the physics law and the physical constants of the ultimate elementary particle have certain relation with the physics law and the physical constants in the universe.

The modern superstring theory is considered as grand unification by some people, a theory which includes everything and describes every natural power under the mathematical framework. In the view of superstring theory, string is the most basic unit and all the elemental particle which formed the universe, for example, electron, photon, quark and neutrino are its specific

states. Up till now, the string theory is only a scientific hypothesis. The human being haven't observed the basic string, yet. The superstring theory is very hard to be proved through experiment, since the extra dimension space is curled so limited, people have to build a particle accelerator as enormously as the galaxy to do the experiment.

According to Kurt Friedrich Göde's un-completeness theorem on math field, in any self-evident axiom form system, there always exits a problem which could not be proved right or wrong of its definition. That's to say any theory has some unsolved problems. Therefore, the grand unification doesn't include all the branch physics theories, while it becomes a common and basic part of all the branch physics. So it must be the most simple and elegant one.

I try to take a lead for the study of elementary particle and the grand unification. This essay is based on the existing theories (e.g. theory of relativity, thermodynamics law) and then it forms a new theory. After all, it isn't built on a new hypothesis.

2. Quantization of information

Claude E.Sannon pointed out information is a kind of characteristic which describes the statistics of a system, is also a basic attribute of the system that they're the organized measurement. Shannon's basic theorem show that a system's containing information equals to the fewest digits of binary system in which we code the perfect describing statistics. The information of a system reflects its possible existing state magnitude. The unit of information measurement is bit. A bit of information is two equal possibilities but chosen one amount of information. For example, one certain system has 2^r possible states. Then its amount of information is r bits.

To observe the possible states is restricted by the Heisenberg uncertainty principle and people's measuring level. Different measuring levels lead to different records of information. In a complete sealed system, we can describe lots of states precisely. We often call them micro states. In the field of quantum mechanics, we consider them as the possible system quantum states. These micro states gather together on different kinds due to different sorts of coarse granulating (which could be called macro states). In a defined macro state, micro states could be considered as equivalence, so we often care the numbers of micro states.

At the same time, if we don't know the final components of a matter or the deepest layer of structure, we could not count the amount of the information and

could not calculate their Shannon entropy of the structure. But we can find deeper layer structure in which we could calculate the information amounts. By the development of micromation technique, we can imagine that in the future quarks could be used to store information. May be a quark could store a bit of information.

3. Shannon entropy

Shannon entropy reflects an uncertainty of a random experiment (or random variable). A random experiment can be expressed as:

$$X = \begin{pmatrix} 1 & 2 & ... & n \\ p_1 & p_2 & ... & p_n \end{pmatrix}$$

In the formula, $1, 2, \ldots, n$ express the possible result, while p_n shows i's probability. X's uncertain value is decided by n's value and p_n's distributing even rate. The uncertainty is a function of $(p_1,p_2,\ldots,p_n)$ and is marked as H. it has the next qualities:

(1) Symmetric continuity. Viz. $H(p_1,p_2,\ldots,p_n)$ is the symmetrical continuous function of $(p_1,p_2,\ldots,p_n)$;

(2) $H(0,1)=0$;

(3) If $q=q_n+q_{n+1}$, then $H(p_1,p_2,\ldots,p_n,p_{n+1})= H(p_1,p_2,\ldots,p_n,q)+ qH(p_n/q,p_{n+1}/q)$.

Through the math deduction, we get the Shannon entropy:

$$H(X) = H(p_1, p_2, ..., p_n) = -\sum_{i=1}^{n} p_i \log_2 p_i$$

log's base is 2, and the unit of H(X) is bit.

If (X,Y) are the duality random variables, valued as (x,y), $x=1,2,\ldots,m$, $y=1,2,\ldots,n$. The united probability distribution is p_{ij}, then their united entropies are:

$$H(X,Y) = -\sum_{i=1}^{m}\sum_{j=1}^{n} p_{ij} \log_2 p_{ij}$$

We call $H(Y|X)=H(X,Y)-H(X)$ as Y for X,s conditional entropy. It shows the conditional uncertainty. When Y doesn't depend on X, Viz.X and Y are separately independent, H(Y|X)=H(Y). we get:

$H(X,Y)=H(X)+H(Y)$

As is known from the concept, thermodynamics entropy has the same equipollence with the Shannon entropy. When Shannon tries to quantify the information from a information, he naturally gets a same formula as Boltzmann's. Boltzmann entropy which represents different forming numbers reflects the amount of Shannon information which is ready for meeting a certain compound mode.

4. A conservation law for entropy and information

Entropy and information have a conservation law that in a information and entropy keep conservative, and equal to the biggest information or the biggest entropy. Viz.:

$$H+I=H_{max}=I_{max}=const$$

H and I refer to the values of entropy and information. H_{max} and I_{max} refer to the most possible values of entropy and information.

The entropy increase principle can be described as the information decrease principle. Namely the information in a sole system can get to its smallest information.

Entropy is an uncertainty measurement. When information is obtained and recorded, energy was used up. In this circumstance the uncertainty decreases. At the same time the recorded information increases. When the record is cleaned, the recorded information decreases. But the uncertainties in the whole closed system increase by the same amounts.

At the same time, entropy has some relation with coarse granulating, Viz. it has something to do with the extent of the described system. Surely, if all the details of a system are considered, we think that their entropy won't increase in the view of math again. So the entropy keeps constant. But in fact, if a system has many parts, we only use some variables to describe it. These smaller variables will add up to other variables due to their

orderliness with the running of time. And then the former ones no longer become orderly. This is the concept of the second law for thermodynamics.

Not only the record of information but also the record of entropy, its result has something to do with people's measuring level and people's considering variables. When we measuring more accurately and consider more variables, we will find out more micro information.

5. The transfer from macro information into micro information

Whether the probability scatters evenly or not shows that a system has distinguished information. We divide the space into 2^r "macro phases". We look on the macro phase information as the needed informations by a group of probabilities which are corresponding with these phases. The probabilities which are distributed in the macro phases can be defined as micro information. In fact, we divide each "macro phase" into 2^q "micro phase". We look on the micro information as a group of corresponding messages needed by the probabilities. Meanwhile, we look on the macro information as the knowledge by which we understand the quality of the whole system. Then we look on the micro information as the knowledge by which we concretely understand every micro particle. In other words, micro information shows that we understand every particle's related speed.

Let's imagine an experiment that in a corner of a close space we place a sealed bottle of perfume in it. The bottle of the perfume was then placed onto a "macro phase" of a certain space. And its cube is $1/2^r$ of which the macro information is r with the running of time, we couldn't see the changes of macro information, because it is under a restricted condition (e.g. the bottle is sealed.). If we take off the lid, with the time gone, the molecules of the perfume will escape from the bottle. And we know that the macro information is decreasing

till all the macro information change into micro information. But the total amounts of information haven't changed at all. We still can go on dividing the micro phases. With the time gone, we may use more accurate measuring method, and we may consider more variables. At last we can find that micro information will change into even more micro information.

If we define the length of even more micro information as Plank length, according to the uncertainty principle, we know that these will become the most micro information. By now if we go on dividing the even more micro information, the information will disappear in the quantum fluctuation, because we couldn't go on doing the measuring any more. In other words, according to the information decreasing principle, when the most micro information goes on decreasing, all the information will disappear in the quantum fluctuation. At the same time, a nominal sole system and the rest parts of the world will interact and they come to action by the way of random disturbances. These perlurbatives will damage the relationship among the particles. Further more, they will consume the micro information.

Macro information can change into micro information and vice versa. Information comes from quantum fluctuation and produces elementary particles with information. By the interaction and relation of these elementary particles, they will produce more information, and then produce macro information. But in

this process, energy will be consumed.

6. Photon is the ultimate elementary particle of matter

As we know an electron has 2^2 possible existing states (it has two electric charges and two spinning states, which is measured by people now). If you want to specify what electron it is, you need 2 digits of binary. So a sole electric, information is 2 bits. As for the photon's spinning, it has two ways of motion which parallels the matter's moving direction or opposite of it. Its least possible existing states are 2^1. So a sole photon, information is 1 bit which is measured by people now. For a sole system which is formed by lots of photons, their left and right spins are equal and scattering evenly. The whole system information is 0 bit.

The least capacity of the information in an elementary particle is 1 bit. Under the uncertainty law, among the elementary particles isn't the least information particle photon?

We know that energy and mass are the same things. If Q for heat quantity, E for energy, T for Kelvin scale, m for mass, S for thermodynamics entropy, we consider a system which has no power with the outer world, according to the first law of thermodynamics, we then get:

$$dQ = dE = dm$$

$$dS = \frac{dE}{T}$$

Obey the principles of energy's equipartition, we get:

$$\frac{E}{T} = const$$

$$\frac{dE}{E} = d(InE)$$

If $dS \geq 0$, then:

$$dm \geq 0$$

Suppose a special in-equilibrium sole system, it can be divided into limitless approximate equilibrium small systems. Due to the fact that entropy and mass can be summarized, we absolutely believe there is such a system, the above formulas are acceptable. Further more, in a sole in-reversible system, if given enough time, the entropy must get to its maximum value and the information must get to its minimum value. Under the restriction of uncertainty law, we can find deeper layer structure in which we could calculate the information amounts. In the deepest layer of structure, when the system information gets to zero, the micro system's single particle must have the fewest information

particles among the elementary particles.

Form the theory of relativity, we get:

$$dv \geq 0$$

v stands for the speed of elementary particles in the special in-reversible sole system.

It shows that the direction of entropy adding up is to make the particle's ultimate elementary particles come to the speed of light. The particle at last will break up into the ultimate elementary particle whose rest mass is zero. That's to say in a completely sole and no restriction physics system, entropy increase principle makes the system's total rest mass zero. Form the theory of relativity, a rest mass which is not a zero matter couldn't be accelerated to light speed. But we think it can be broken up into light speed photon. So photon's rest mass is zero and its information is 1 bit particle. It is the ultimate elementary particle of matter. Namely the fastest speed is photon which is also the fewest information particle. Photon is the limit while dividing the elementary.

On the other hand, we can use photon to form a coordinate in order to survey a sole physics system. Based on theory of relativity, we will find those which form the physics system are all light speed particles, Viz. photon. Generally speaking, people won't build a photon coordinate to survey a sole physics system, because it is the extreme condition. But if a common physics law could not apply to an extreme condition, what is the

common?

Either using information decrease principle, or entropy increase principle or photon coordinate principle to survey matter, we can draw a conclusion that photon is ultimate elementary particle of matter.

7. Information and rest mass

Suppose there are two photons A, B. They are moving in light speed. Their moving mass (total kinetic energy) are m_A, m_b. Since A,B are owning moving mass, they also have some magnetic characteristic. A and B combine into an elementary particle ------ a particle which has "strong character", when photons interact with each other, and produce position energy.

Now, we suppose the position energy of A, B are V_A^*, V_B^*.The total moving energies are m_A^*, m_B^*. Then the total energy of A and B is:

$$V_A^* + m_A^*, V_B^* + m_B^*$$

Considering A, B as a general M, then M's total rest mass m is:

$$M = V_A^* + m_A^* + V_B^* + m_B^*$$

The rest mass (Viz. proper mass) which consists of the ultimate elementary particles is the total value of position energy produced in the circumstance that the matter's inner particles interact with each other and total moving energy produced in the circumstance that matter's inner particle are moving towards each other.

In a completely sole and no restriction physics system, following the information decrease principle, with the time going, its ultimate information is 0 bit. We can say that it has no information. At that time, the total rest mass in the whole physics system is also zero. When a

physics system owns rest mass, it proves that the inner interaction between photons and particles. So it produces information and vice versa. If the physics system exists information (>1 bit), it shows that it owns rest mass. The matter's information and rest mass are produced by the interactions between photons and particles. If an electron owns information (2 bit), it also owns mass. But by now, we couldn't come to a conclusion that how much information there is decide how much rest mass there is. What we need is a further study.

Photon form matter by a certain way. By the interaction between the photons (or by the effect of power) or by transformation it will form a rest mass particle. At the same time, it will produce position energy and then produce new information and the next produce rest mass. Perhaps we can no longer survey a certain photon of the matter inner. Electron and anti electron can die into a pair of photon. Similarly, several photons could change into an electron.

8. The micro information in the whole universe

Firstly, let's consider the universe as an endless "straight line" model. In order to stress the uncertainty principle, we must divide the one dimension line into line segments. Each length of the line segments stands for the position of the particle and its possible accuracy. If we can confirm the numbers of the particles in each segment, then, about the "straight line" universe, we can use limitless sequence of the particles to express the universe which is formed by "occupation numbers" and open at both ends. The micro information is defined as: it helps us to distinguish two same statistics (macro) character occupation number sequences. Now we try to prove the two sequences are same. We will chose a subsidiary sequence from a occupation number sequence. In a limitless sequence, any length-limited subsidiary sequence will repeat to appear endless times. According the large numbers law after finite times of attempt, we could find out some possessing same characteristic occupation subsidiary sequence. Moreover, despite the length of the chosen subsidiary, so long as the length is finite, we can find that kind of sequences.

We extend the above proof to the three-dimension endless universe. So long as it meets the condition that the strong universe principle and the part universe structure are limit, the whole universe character is all statistics (macro) and its micro information does not

exist at all.

9. The physics character and physics constant of photon affect the universe's physics law and physics constant

Photon has the character of quantization. Its energy is:

$$m = \frac{hv}{c^2}$$

h is the Plank constant, *v* is frequence.

Due to the quantization of photon, we think photon can be compounded and broken down. Nevertheless, if its rest mass is zero, it is a photon. For separate particles, they all have the same physics characteristic. Only in different fields, they show different physics characteristics.

Photon owns the characteristics of quanta and electromagnetic. Light speed is its physics constant. The universe consists of photons. So the photon's physics characteristic and constant affect the universe's physics law and constant. If the whole universe consists of many small universes, the photon's physics characteristic and constant in each small universe affect the physics law and constant of this small universe. No matter what circumstance it is, anything happening in the universe seems that its evolution is based on the science laws. All these are affected by photon's physics characteristic and constant. It is the direction for people of modern physics to study photon's physics characteristic and constant.

I believe that in the future people will know more about photon’s nature and will know more about the matter’s structure.

(Note: This essay is adapted from a part on "energy-momentum theory" which was written by me in 1992. it is only a chapter of my book, "The proof that photon is the ultimate elementary particle of matter". At first I named the particle whose value of rest mass is zero as zero-particle. But later I think using the word of "photon" is better.)

Zhuopeng Xian
Written in 1992

后记

＜光子是物质的最基本粒子＞的概念在于更新人们的观念。她的理论是建立在旧有的理论（狭义相对论及热力学定律）基础上的一个新的推论，而不是建立在一个新的假设之上。若然推论无误，我们要么承认这个理论，要么推翻狭义相对论及热力学定律。

2006 年 10 月
醉放先生

二先网络
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